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THE ASPEN LAKE FIRE, OREGON

Report of Barkbeetle Developments on the Burned Area and on Adjacent Stands (Pine) Subsequent to Fire

by

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Table of Contents

	Page
General Summary	1
Introduction	3
The Fire	3
Character and Acreage Covered	3
Previous Examination and Recommendation	3
Salvage by Logging and Control Work	3
Present Paper-Value	3
Condition on Burned Area Immediately After Fire	4
Types of Fire	4
Classification of Fire Damage	4
Per Cent of Damage to Fire-Injured Trees	4
Logging Operations	5
Per Cent of Burn Logged	5
Classes of Fire-Injured Trees Salvaged	5
Volume of Timber Logged and Salvaged	5
Insect Losses Within the Burned Area	5
Sample Plots Cruised	5
Insects Responsible for Losses	5
Classes of Fire-Injured Trees Attacked	5
Trees Most Susceptible to Attack	6
Comparison of the Cycle of Infestation in Burned Area and in Adjacent Stands	6
Number of Trees Attacked on Check Areas	6
Concentration of Beetles on Burned Area	6
Results of Control Work in Adjacent Stands	6
Comparison with Other Burns	7

Table of Contents, concluded

Page

Development of Western Pine Beetle Broods in Fire-Injured Trees - 7

Attacks per Square Foot of Bark - - - - - - - - - - - - - - - - 7
Beetles Attacking per Square Foot- - - - - - - - - - - - - - - 7
Beetles Emerging per Square Foot- - - - - - - - - - - - - - - - 7
Comparison of These Averages with Normal Median- - - - - - - 8
Mortality of Broods in Fire-Injured Trees - - - - - - - - - - 8

Fig. 1 - Relative number of trees attacked annually in each class of fire injury on burned check area - - - - - - - 9

Fig. 2 - Relative number of trees attacked annually on burned and unburned check areas- - - - - - - - - - - - - - 10

Map of burned area and surrounding forest areas - - - - - - - - 11

Appendix - Photographs of examples of fire injury to western yellow pine

GENERAL SUMMARY

The Aspen Lake Fire occurred in June and July, 1926. A total of 8,000 acres of virgin forest was burned over. The volume of stumpage on the burned area has been estimated at 80,000 M.B.M., of which 70 per cent was yellow pine and 30 per cent fir.

The intensity of the fire varied from a light ground fire to a severe crown burn. About 10 per cent of the area was burned over by a light ground fire, resulting in practically no damage to standing timber. On about 40 per cent the fire was of medium intensity, scorching the lower crowns and trunks of merchantable trees, while a fairly severe ground fire burned over 30 per cent, killing the foliage on practically all dominant trees. The fire crowned on the remaining 20 per cent with disastrous results, killing outright more than half the trees on these areas.

The owners of the damaged timber, the Weyerhaeuser Timber Company, inaugurated salvage operations on the burned area during the fall of 1926, and control work in the adjacent unburned stands, in an effort to save the fire-killed stock and to prevent an epidemic of barkbeetles in the injured trees. This salvage operation was completed the following season. About 1,500 acres, or 19 per cent of the area was logged. A total of 12,700 yellow pine trees, containing a total volume of 15,272,704 b.f., were cut. The salvaged stock was milled on the burned area.

The fire-injured yellow pine trees were susceptible to attack by the western pine beetle. A small concentration of these beetles took place on the burned area in the fall of 1926, and this status was maintained through 1927 and 1928. Trees that suffered the most severe fire injury were selected by the beetles during the first season following the fire. Thereafter they favored trees which had been scorched but not greatly injured.

Because of the logging operations on the burned area and the control work in 1926 in the adjacent unburned stands, which resulted in greatly reducing the beetle infestation on these areas, natural conditions were upset and it was not possible to determine what conditions would normally have developed. The data secured support the following conclusions:

There was only a slight concentration of beetles on the burned areas the first season following the fire. This was attended by a correspondingly small decrease in the adjacent unburned stands. These relative conditions persisted through 1927 and were still maintained in 1928. In this respect conditions on this burn have not been consistent with those on other burns studied during the past ten years, where there was a high concentration of beetles on the burned area immediately following the fire.

It is believed that the logging of the salvaged stock and the control work which was carried out in the adjacent timber stands served to lessen the barkbeetle losses on the burned area, which would otherwise have been greatly increased.

The number of beetles attacking the individual fire-injured trees was lower than in normal attacks. This bears out the data secured in other fire studies.

The development of beetle broods in these trees was attended by the mortality usually suffered by broods in fire-injured trees. The rate of mortality rose consistently with each succeeding degree of fire injury. The number of beetles which emerged from the trees most severely fire-injured was less than the number which attacked.

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INTRODUCTION

The summer of 1926 was marked by one of the worst fire seasons known in the pine belt of southern Oregon. Among a number of damaging forest fires which occurred during this season, the Aspen Lake burn was one of the most destructive to merchantable timber. This fire started June 24 and continued until July 3, burning over about 8,000 acres of virgin forest on the west side of the lake. It started at a point southwest of the lake and progressed northward, paralleling the shore line and extending back from one to two miles to the steep slopes of Aspen Mountain. It extended the full length of the lake, a distance of six miles. The volume of stumpage on the burned area has been estimated at about 80,000 M.B.M. About 70 per cent of this volume was western yellow pine and the remaining 30 per cent was Douglas fir and white fir.

The owners of the timber, the Weyerhaeuser Timber Company, anticipating a rather high barkbeetle loss in the fire-injured trees as well as a total loss of the trees killed directly by the fire, undertook to salvage the damaged stock. To this end logging operations were started on the burned area in the fall of 1926, two months after the fire, and were continued through the working season of 1927.

In July 1926, previous to the beginning of the salvage operations, an examination was made of the burned area by J.M. Miller and the writer. A report was submitted to the owners showing the class of fire-injured trees most likely to be attacked by barkbeetles and which, for this reason, should be salvaged.

The owners of the timber, acting upon these recommendations, not only began early salvage of the fire-injured trees susceptible to attack, but also in the fall of 1926 carried out control operations in the adjacent stands, in order to reduce this nearby infestation and thereby prevent a great concentration of beetles on the burned area.

In order to ascertain the subsequent barkbeetle developments in the fire-injured trees and the surrounding stands, a second examination of these areas was made in August 1928. The information secured in this examination is included in the present report.

Because of the logging of a high percentage of fire-injured trees susceptible to beetle attack, and the control work in the adjacent unburned stands, the normal trend of the infestation was greatly upset, so that the subsequent developments were quite different from the usual conditions following a fire of this character.

In addition to the data secured on the development of beetle broods in the trees weakened by the different classes of fire injury, which are of value in supplementing other studies of this character, the most valuable information obtained from this study concerned the behavior of the infestation following the fire, where the controlling influences resulting from the removal of fire-injured trees and control work were both effective.

CONDITIONS ON BURNED AREA IMMEDIATELY AFTER FIRE

In describing the conditions on the burned area the standard classification of fire types created by J.M. Miller is used.

Type 1 - Light ground fire, no injury to foliage or trees. This type occurred in open stands of well-spaced mature trees with no brush cover and the minimum of young growth. It represented less than 10% of the burned area.

Type 2 - Medium ground fire, reaching to the lower crown of mature trees and killing the lower limbs. Brush and young trees killed. About 40% of the area.

Type 3 - Fairly severe ground fire, resulting in the death of practically all foliage of dominant trees and killing of the lower half of the crown. Brush and young trees consumed. About 30% of the burned area.

Type 4 - Severe crown fire. Direct fire loss of more than 50% of dominant trees and all young growth. The fire crowned on about 20% of the area, where a high fire loss was sustained.

CLASSIFICATION OF FIRE DAMAGE

The standard classification of the varying degrees of fire injury and the relation of such injury to barkbeetle attack which has previously been adopted is followed in this report.

Classes of fire injury expressing extent of damage to individual trees:

I - No visible fire injury
II - Up to 25% of crown defoliated
III - 25% to 50% of crown defoliated
IV - 50% to 75% of crown defoliated
V - 75% to 100% of crown defoliated but with terminal buds and cambium green
VI - 100% defoliation. Cambium severely injured, terminal buds killed and limbs burned. Many such trees are killed outright by fire.

Illustration of these classes of fire injury is shown in the photographs of appendix.

No estimate of the volume of timber represented in each of these classes of fire injury was possible because of the removal of the majority of the damaged trees in the logging operations. However, enough trees of each class were left to indicate the trend of the beetle infestation and the development of the broods in these trees.

LOGGING OPERATIONS

Logging of the fire-damaged trees was started in the fall following the fire and completed the following season. The trees were milled on the ground. The salvage of the stock was effected before it had greatly deteriorated, although a rather high percentage of the sapwood of the fire-injured pine was affected by blue sap-stain, which degrades the lumber.

In the logging no effort was made to dispose of the slash aside from burning the slabs at the mills to prevent emergence of any barkbeetles that may have been in them.

About 1500 acres, or approximately 19 per cent of the burned area was logged. The area logged was not a continuous one, but was made up of a number of more or less isolated small areas located largely in the yellow pine stands where the fire was of the character of Types 3 and 4; i.e., fairly severe ground burn and crown fire.

The majority of pine trees salvaged in this operation were distributed among the types of fire injury included in Classes IV, V and VI, with the greatest percentage falling in Class VI. A total volume of 15,272,704 board feet of pine (about 12,700 trees) and 781,169 board feet of fir were salvaged in the operation.

INSECT LOSSES WITHIN THE BURNED AREA

A number of small plots, aggregating 320 acres, of the burn outside the logged areas were cruised in order to estimate the barkbeetle loss in fire-injured trees. The western pine beetle was the most important agent in killing these weakened trees. The mountain pine beetle, Ips oregoni, Ips emarginatus, and roundhead and flathead borers were also present, but they were incidental to the more important western pine beetle.

Only merchantable trees, or trees above 12 inches stump diameter, were tabulated in this survey.

The insect loss on these sample plots was distributed among the various classes of fire-injured trees as follows:

Number of Merchantable Trees Attacked in Each Class of Fire Injury

	Year Attacked		
Class	1926	1927	1928
I	9	25	9
II	11	20	5
III	13	34	43
IV	11	92	51
V	119	13	0
Totals	163	184	108

These data show that immediately following the fire the beetles evinced a pronounced preference for trees in Class V. However, many of the attacked trees in this class may have died from fire injury alone, the beetle attacks occurring while they were in a dying condition. This supposition is borne out by the relatively small number of trees in this class attacked in 1927, the succeeding season.

During 1927 a marked preference for trees in Class IV was shown, while trees in Class III were also favored. This same tendency continued throughout the 1928 season. This seems to indicate that trees suffering these two classes of injury are greatly preferred by barkbeetles even after two seasons have elapsed since injury. Why this should be so is perhaps answered by a study of the effect of fire injury on tree growth. Trees in Classes III and IV are rather severely defoliated by fire, which results in a sudden checking of growth rate. Person has shown that the western pine beetle consistently prefers slow-growing trees. This discrimination by the beetles probably accounts for the selection of trees in these classes.

COMPARISON OF THE CYCLE OF INFESTATION IN THE BURNED AREA AND IN ADJACENT STANDS

In order to determine the amount of concentration of the beetle population in the fire-injured stands, two areas of 320 acres each were cruised; one was located within the burn, while the other was situated east of Aspen Lake at a distance of from one-half to one mile from the burned area. The following table gives the result of these cruises:

Number of Trees Attacked on 320 Acres of Burned Area and on 320 acres of Adjacent Unburned Check Area

Area	Number of Trees Attacked Each Year		
	1926	1927	1928
In burn	153	184	108
Adjacent to burn	104	72	36

These data are shown in graphic form in Fig. 2.

No definite conclusions can be drawn from these figures because control work was carried out in all the adjacent unburned stands in 1926, which no doubt upset the normal trend of the infestation. However, a comparison of the number of trees killed each year on the two areas shows that there was a small concentration of beetles on the burned area immediately following the fire and that this concentration was maintained through 1927, one year after the fire, and has persisted in lesser degree through 1928, being slightly higher each year than the attacks on the check area.

The annual infestations on both areas for two years preceding the fire were high for this region and averaged about 250 attacked trees per section each year. Taking these data as a basis the trend of the infestations since 1925 shows a small decline in 1926 in the unburned stands and an increase on the burned area. The divergence between the cycles of infestation on the two areas was still further increased in 1927 by a continued decline of attacks in the unburned stands and an increase on the burned area. In 1928 the infestation on both areas decreased, [illegible] with a wider relative spread.

Despite the logging operations on the burned area and the control work outside, which upset the natural conditions and complicated analysis of results, the following conclusions seem obvious:

There was a small concentration of beetles in the fire-injured stands during the first season following the fire. This condition on the burned area was accompanied by a corresponding slight decrease in infestation in the adjacent unburned stands. These same conditions were further emphasized in 1927, the succeeding season, and they still persisted, though in a smaller degree, through 1928.

Because of the logging operations on the burned area and the control work in the adjacent stands, which resulted in greatly reducing the infestation on these areas, it is impossible to estimate the developments which would otherwise have followed the fire. It is very probable that if the logging had been neglected and no control work done a much more serious situation would have developed. The unreduced infestation in the untreated stands would have contributed a much greater influx of beetles to the burned area. These beetles, together with those emerging from the infested trees which were logged, would have combined to form an infestation much more severe than the one which did develop. Such was the subsequent history of two other burns studied in the same locality in 1918 and 1919. On one of these, the Mistletoe Burn, the beetle infestation on the burned area increased over 1100 per cent the first season following the fire; while on the other, the Siskiyou Burn, the increase in infestation immediately following the fire amounted to 1950 per cent.

DEVELOPMENT OF WESTERN PINE BEETLE BROODS IN FIRE-INJURED TREES

In previous studies of the development of beetle broods in fire-injured trees it was found that development was not normal, and that a high rate of mortality occurred between hatching of the eggs and emergence of the new beetles. In order to secure data on this phase of the problem a section of bark was removed from 25 abandoned trees and analyzed. The trees sampled were selected to represent all classes of fire injury. Entrance holes, representing the beetles attacking, and exit holes, representing the beetles emerging, were counted in each section removed. These counts are summarized in the following table:

Class	Average Diameter of Trees Sampled	Averages per sq.ft. of Bark		
		Attacks	Bts.Attack.	Bts.Emerg.
I	24	15.6	27.2	59.8
II	26	16.5	33	54.5
III	24	14.7	29.4	34.7
IV	22	11.7	25.4	26.7
V	29	7	14	1.5

The mean normal ratio of beetles attacking to beetles emerging is 22 to 64. These median values are based on analyses of over 4,000 square feet of bark, and are assumed to be normal for the average western pine beetle brood. Comparison with the above averages shows that the rate of increase in trees of Classes I and II is slightly below normal; in trees of Classes III and IV the rate is still lower, while in trees of Class V the mortality of the beetle broods was so high as to result in a decided decrease. The basis for these conclusions is admittedly small, because only 25 trees were examined. The small amount of material is hardly sufficient for a complete analysis, since examination of an additional set of 25 trees selected in another part of the burn may have given slightly different results.

However, the mortality recorded in these counts is in agreement with similar data from other studies of brood development in fire-injured trees. A significant fact revealed by these counts is the reduction in number of beetles attacking per square foot in Classes IV and V. This difference also is consistent with other fire studies, and seems to be due to the lack of resistance to attack by fire-injured trees. In trees of normal vigor greater concentration of attack is essential to overcome the natural resistance of the sap flow.

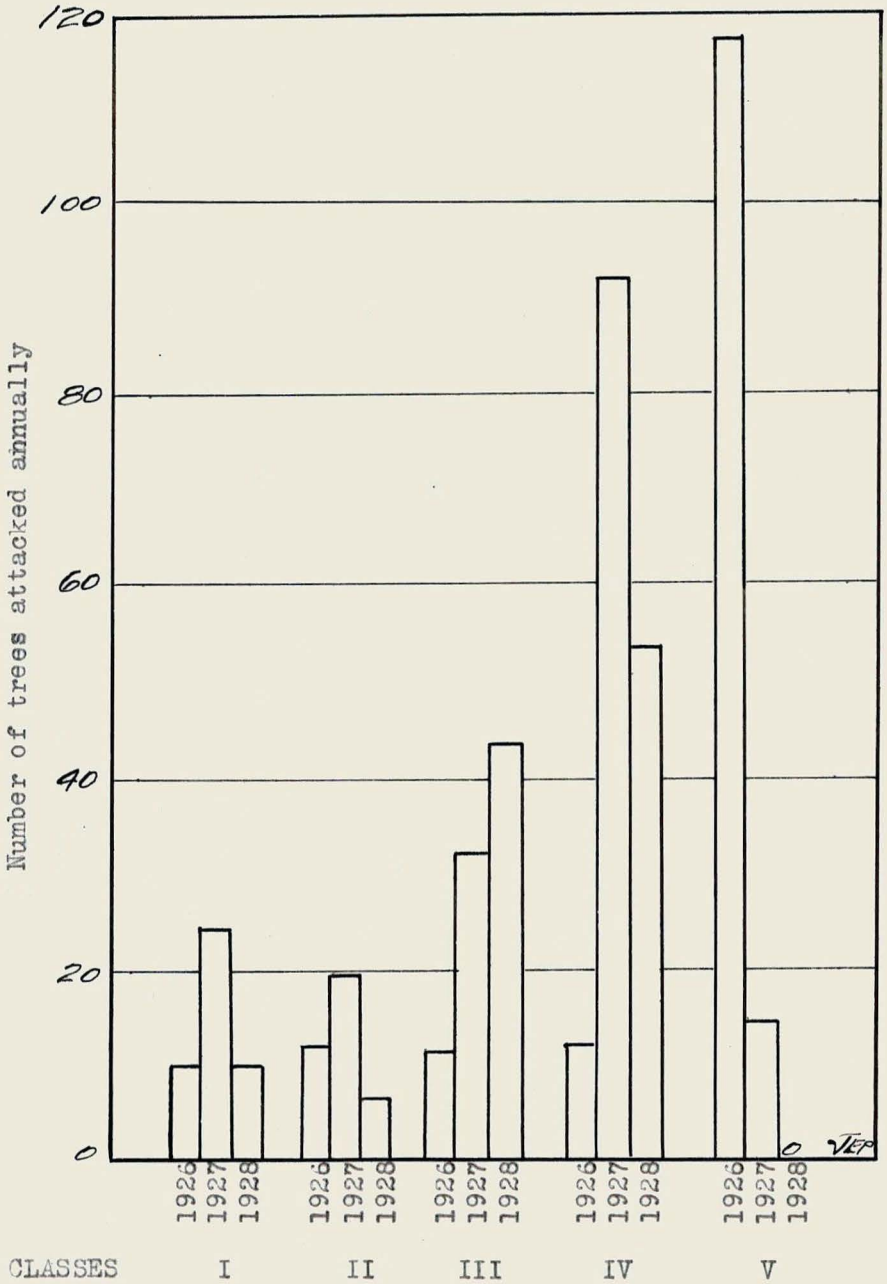

Fig. 1. Relative number of trees attacked annually on burned check area by barkbeetles in each class of fire injury for three seasons subsequent to fire.

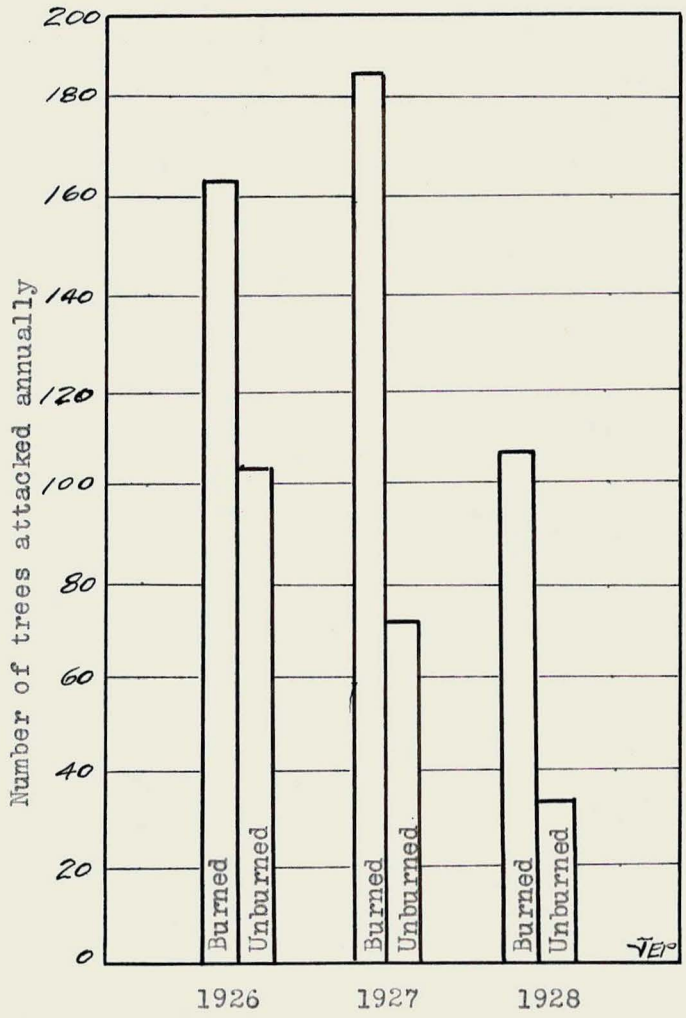

Fig. 2. Relative number of trees attacked annually on burned check area and on adjacent unburned check area for three seasons after fire.

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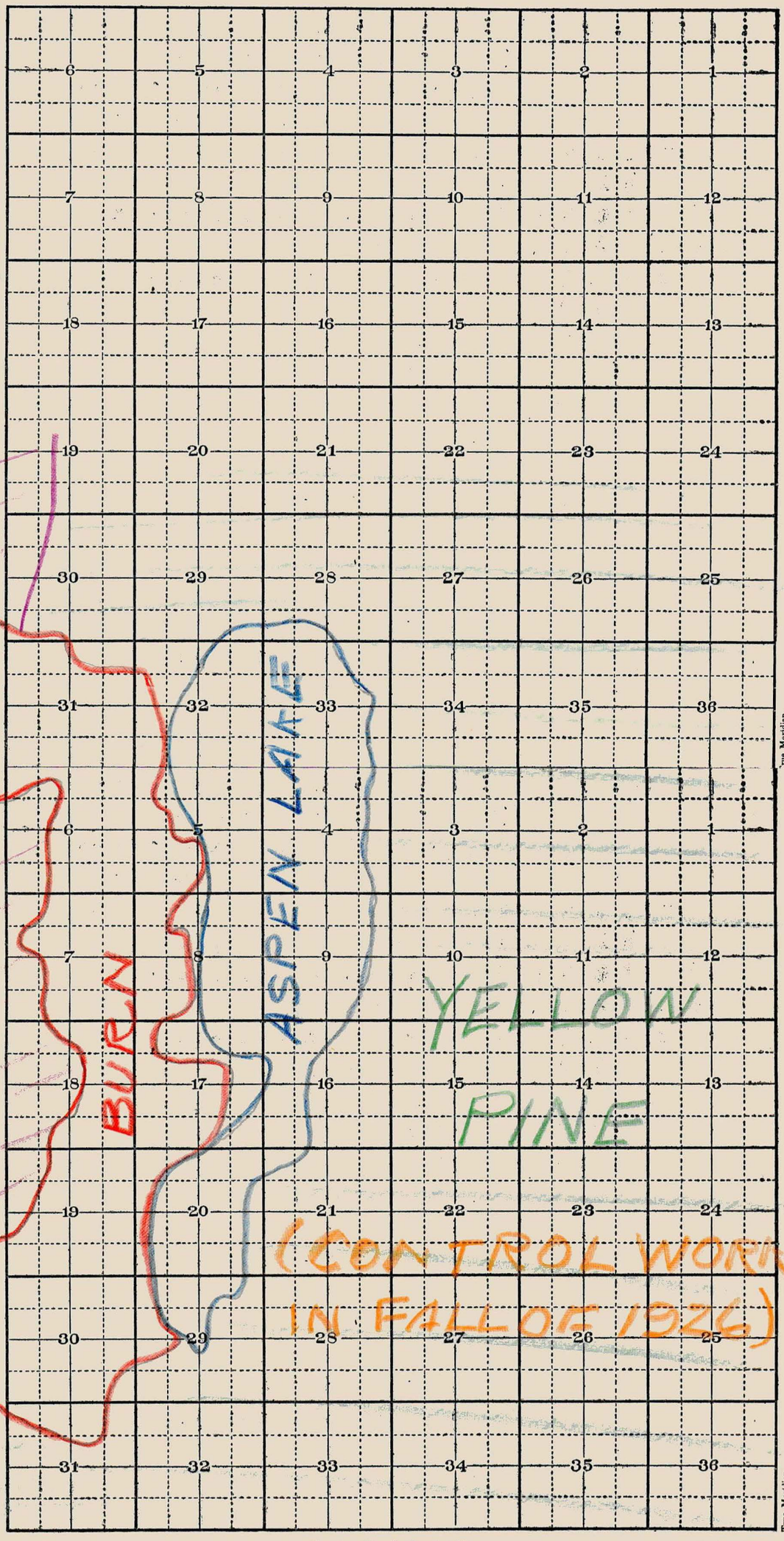

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SCALE.—One inch = 1 mile.

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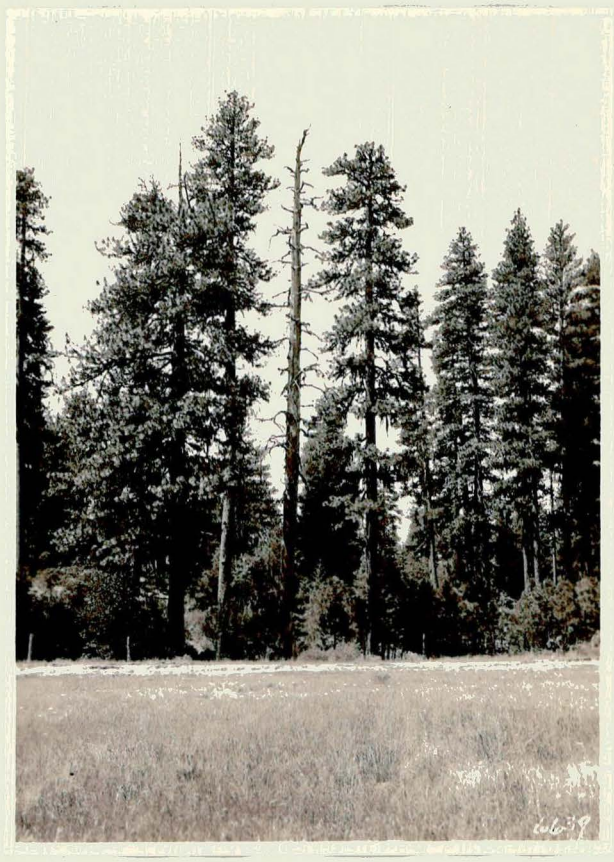

CLASS I - Trees uninjured by fire. These trees, although within the burned area, are not more susceptible to bark-beetle attack than are trees under normal conditions.

CLASS II - Trees slightly fire scorched. Less than 25% of the foliage killed and light charring of the lower trunk. These trees are not greatly susceptible to barkbeetle attack.

CLASS III - Trees moderately fire scorched. From 25% to 50% of the foliage burned away and the lower limbs killed. Many trees suffering this degree of injury are subsequently attacked and killed by bark-beetles. If they are not attacked during the first two seasons following fire injury their chance of survival is good.

CLASS IV -- Trees heavily fire scorched. From 50% to 80% of the foliage burned and the limbs up to the middle crown killed. These trees are highly susceptible to bark-beetle attack. The three trees shown in the foreground were attacked and killed by the western pine beetle in 1927, one year after the fire.

CLASS V - Severe fire injury resulting in the loss of 90% of the foliage and charring of the entire trunk. These trees are almost always attacked by bark-beetles and wood-borers.

CLASS VI – Trees killed outright by fire. Entire foliage, and small limbs and twigs burned away. Such trees are seldom attacked by barkbeetles but are attractive to woodborers. The examples shown were in a stand of mixed pine and fir type where the fire crowned.

Trees of Class III which survived a former fire that occurred many years previous. Note that the trees have shed the lower crown which was killed by the fire. These trees were not injured by the last fire.